REMARKS

Claims 14-33 are pending in the application. Claims 14-28 stand rejected. Claims 29-33 are objected to as being dependent upon a rejected base claim. Independent claims 14, 21, and 28 are being amended. New claims 34-44 are being added. Support for new claims 34-44 is found in the specification as originally filed. No new matter is believed to be introduced by way of the new claims.

Claims 17-20 and 24-27 were rejected under 35 U.S.C. 112, second paragraph. Corrections to these Claims have been made in the Claim Listing above and described below. Claims 14-16 and 21-23 were rejected under 35 U.S.C. 102(b) as being anticipated by Yatrou et al. (U.S. Patent No. 6,181,794), hereinafter referenced as "Yatrou."

Claim 14 as amended in the Claim Listing above recites,

> filter tap coefficients in an echo canceller, comprising: adapting high-energy filter tap coefficients and low-energy filter tap coefficients when using adjustable gain constants, based on an occurrence of a first predetermined condition occurs; and separately adapting the high-energy filter tap coefficients from the low-energy filter tap coefficients when based on an occurrence of a second predetermined condition occurs,

where the strikethrough words indicate elements being deleted by way of amendment, and the underlined words indicate elements being added by way of amendment. Support for the amendment is found in the specification as originally filed at least on page 15, paragraph bridging pages 15 and 16

> Preferably, the adaptive filter $\hat{h}$ uses a Normalized Least Mean Square (NLMS) adaptation process to update its tap coefficients. In accordance with the process, coefficients are adapted at each time n for each tap $m=0, 1, \ldots, N-1$ in accordance with the following equation:
>
> $$\hat{h}_{n+1}(m) = \hat{h}_n(m) + \frac{a_n}{\sum_{i=0}^{N-1} x_i^2} e_n x_{n-m}$$
>
> where $\hat{h}_n(m)$ is the mth tap of the echo canceller, x_n is the far-end signal at time n, e_n is the adaptation error of time n, and a_n is the adaptation gain at time n.
> The foregoing adaptation process will converge in the mean-square sense to the correct solution the echo path response h if $0 < a_n < 2$. Fastest convergence occurs when $a=1$.

However, for $0 < a \leq 1$, the speed of convergence to h is traded-off against steady-state performance.

Referring to Applicants' Figure 5, an error performance surface is illustrated having a parabolic shape in an upward z direction, where the error performance surface 185 is defined to be the mean square difference between an adaptive filter $\hat{h}$ and an echo response h in the form of a $N+1$ dimensional bowl (in the present case, $N = 2$). The bottom of the bowl is $\hat{h}$ which produces the least mean square error, i.e., h. The normalized least mean square (NLMS) process iteratively moves the $\hat{h}$ towards h at the bottom of the performance surface as shown by arrow 190. The adjustable, non-binary gain constant a is employed to control the trade-off between the steady state error and the speed of convergence to h. When $a=1$, $\hat{h}$ moves to the bottom of the bowl most quickly, resulting in a fast convergence. When $0 < a < 1$, then the steady state error is smaller but $\hat{h}$ requires a longer time to converge.

In contrast, the invention disclosed by Yatrou lacks the means necessary to control and adjust the trade-off between speed of convergence and steady state error. Specifically, the method disclosed by Yatrou employs two filters, both of which must be active at all times. The first filter is a subrate filter that determines the active regions of the impulse response. The second filter is an adaptive filter that is used for echo cancellation. The output of the first filter is used to control the active taps in the second filter. However, Yatrou neither discloses use of adaptive gains nor allows for the admission of gain constants into the existing formulation. As Yatrou describes in Column 5, lines 6-40, as well as FIG. 4,

the sub-rate taps are divided into 24 contiguous regions of 4 taps each (time aligned with the 24 full-rate regions) and every 2 ms., the tap magnitudes 40 are each squared by squaring circuit 41 and weighted by multiplying the squared value by a constant, before being summed at summer circuit 42a within each region. The equation which provides an indication of the section activity is given by:

$$S_k = \underset{n=1}{\overset{4}{Sum}}(a'_{4*(k-1)+n}(m)^\wedge 2 * w(n)), \quad K = 1,\ldots,24$$
$$(w(1),w(2),w(3),w(4)) = (8,12,16,16)$$

For example, summer circuit 42a provides a sum of the weighted squared values *(w)* for the sub-rate tap values $a'_j, j=1 \ldots 4$, summer circuit 42b provides a sum of the weighted squared values for the sub-rate tap values $a'_j, j=5 \ldots 8$, etc. This is done every 16

samples (500 times per second). The comparer circuit 43 will find the largest sum over dormant sections S_i and it will find the smallest sum over active sections S_j. Using this information, the active region with the lowest sum is deactivated and the dormant region with the largest sum is activated, but only if the latter is greater than the former. That is, if $S_i > S_j$, then section j is deactivated and section i is activated. In general, there are 5 active and 19 inactive sections.

Thus, Yatrou does not disclose gains; Yatrou merely discloses use of active and dormant regions. Applicants' new Claims 43, 44 ("the adjustable gain constants are binary") further distinguish over Yatrou. Moreover, although the method claimed by Applicants in amended Claim 14 and that of Yatrou's patent both employ a dual filter design, the method now claimed by Applicants provides a significant improvement over that enclosed by Yatrou due to its use of adjustable, non-binary gain constants. As mentioned above, the adjustable gain constants may be used to control trade-offs between speed of convergence and steady state error.

Accordingly, Applicants respectfully submit that the rejection of amended claim 14 under 35 U.S.C. 102(b) is overcome.

Independent claim 21 is being amended to include the same elements ("using adjustable, gain constants, based on an occurrence of a first predetermined condition") as amended Claim 14. Accordingly, Applicants respectfully submit that claim 21 overcomes the rejection under 35 U.S.C. 102(b) for the reasons presented above.

Because claims 15-16 and 22-23 depend from now amended claims 14 and 21, these dependent claim should be allowed for at least the same reasons as the base claims from which they depend.

Claim 17 as amended recites, "first predetermined condition is an existence of a non-linear echo response path scenario". Support for the amendment is found in the specification as originally filed on page 25, first two sentences of the first full paragraph ("A further scenario in which it is desirable to alter the gain of the adaptive filter $\hat{h}$ is when the echo path response is non-linear. The presence of non-linearities in the echo path encourages constant minor changes in the coefficients $\hat{h}$ in order to find short-term optimal cancellation solutions").

Claim 24 as amended recites, "first predetermined condition is an existence of a non-linear echo response path scenario". Accordingly, applicants respectfully submit that claim 21 overcomes the rejection under 35 U.S.C. 112 for the reason presented above.

Claim 18 as amended recites, "first predetermined condition is <u>an existence of</u> a data call ~~scenario~~". Support for the amendment is found in the specification as originally filed on page 29, the last full paragraph ("There are some scenarios in which it is desirable to assume that some taps are more significant than others. Two examples are non-linear echo path scenarios (e.g. data calls having narrow bandwidths of the signaling frequencies").

Claim 25 as amended recites, "first predetermined condition is <u>an existence of</u> a data call ~~scenario~~". Accordingly, Applicants respectfully submit that claim 25 overcomes the rejection under 35 U.S.C. 112 for the reason presented above.

Claim 19 as amended recites, "first predetermined condition is [[a]] <u>an existence of a</u> narrow bandwidth <u>signal</u> ~~scenario~~". Support for the amendment is found in the specification as originally filed on page 23, first two sentences of the last full paragraph ("A further condition in which the adaptive gain may be altered from an otherwise usual gain value occurs when the adaptive filter $\hat{h}$ is confronted with a far-end signal that is narrow band, i.e. comprised of a few sinusoids").

Claim 26 as amended recites, "first predetermined condition is ~~a~~ <u>an existence of a</u> narrow bandwidth <u>signal</u> ~~scenario~~". Accordingly, Applicants respectfully submit that claim 21 overcomes the rejection under 35 U.S.C. 112 for the reason presented above.

Claim 20 as amended recites, "second predetermined condition is <u>convergence to</u> a linear echo path ~~scenario~~". Support for the amendment is found in the specification as originally filed on page 27, second sentence of the second full paragraph ("consider the scenario in which the echo canceller 25 must converge to a linear echo-path. Since some flat-delay is to be expected, the span of time covered by the coefficient of the $\hat{h}$ filter should be larger than the expected duration of the echo-path response").

Claim 27 as amended recites, "second predetermined condition is <u>convergence to</u> a linear echo path ~~scenario~~". Accordingly, Applicants respectfully submit that claim 27 overcomes the rejection under 35 U.S.C. 112 for the reason presented above.

Claim 28 as amended recites,

> A method for searching for filter taps for adaptation, comprising:
> searching for a first group of filter taps associated with a first energy level;
> biasing a group of filter taps adjacent to the first group; ~~and~~
> searching for a second group of filter taps associated with a second energy level;
> <u>and repeating the searching for the first group of filter taps, biasing the group of</u>

> filter taps adjacent to the first group, and searching for the second group in an iterative manner to adapt the first and second groups of filter taps.

Support for the amendment is found in the specification as originally filed on page 28, "the echo canceller 25 divides the taps into window sections," which need not have the same number of taps. The echo canceller then tags windows with the largest amount of energy as being more significant than others. Coefficients of taps in tagged windows are then adapted using a higher gain constant a_n, which is used for regulating convergence. A different gain constant a' is used to adapt lower energy windows. This coefficient need not equal zero.

Additionally, referring to the specification as originally filed on page 29, second sentence of the second full paragraph,

> The tags are placed on the windows iteratively, that is, once one section is tagged, a new search is conducted to find the next tagged section. In order for these tagged windows to lump together into not more than a few larger sections, which is often desired, two steps are taken. First, a section which immediately follows a tagged section is biased in the large energy search by an additive or multiplicative constant, thus making it more likely to be chosen. Second, when a section is tagged due to the above search, one, two or more adjacent untagged sections are also tagged.

In contrast, Yatrou divides the taps into multiple blocks with equal numbers of taps and uses a sub-rate filter to estimate the five most active blocks of taps. These five blocks are referred to as the "active regions" in the full-rate filter. The sub-rate filter finds the largest sum over the "dormant regions" as well as the smallest sum over the active regions. As Yatrou describes in column 5, lines 29-32, "Using this information, the active region with the lowest sum is deactivated" by being set to zero and "the dormant region with the largest sum is activated". This is only done if the largest sum in the dormant region is greater than the smallest sum in the active region.

Accordingly, Applicants respectfully submit that the rejection of claim 28 under 35 U.S.C. 102(b) is overcome and, therefore, the objection to claims 29-33 is also believed to be overcome.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims that will be pending after entry of this amendment, Claims 14-44, are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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